ELECTROPHYSIOLOGICAL CHARACTERIZATION OF THE FUNCTIONAL STATE OF THE BRAIN IN MENTAL DISTURBANCES IN WORKERS INVOLVED IN THE CLEAN-UP FOLLOWING THE CHERNOBYL ATOMIC ENERGY STATION ACCIDENT

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Studies were carried out on 150 workers with mental disturbances, who had been involved in the clean-up of the Chernobyl atomic energy station accident. Visual and computer analyses of EEG traces from 43 workers were compared with traces from 17 healthy subjects, and the comparison revealed that the most common features in workers were disorganization of the $\alpha$-rhythm and strengthening of $\beta$-1-activity in the sensorimotor cortex. In neurosis-like syndromes (13 patients), there was a significant increase in the power of the $\alpha$-rhythm in the anterior parts of the cortex; in psycho-organic states, power was significantly reduced (especially in the left hemisphere), contributing to the greater proportion of flat EEG traces in patients with psycho-organic syndromes as compared with other groups of patients. Most patients among the clean-up workers had increased assimilation of flashing light rhythms and weakening of non-specific and skin galvanic responses to a light stimulus. It was concluded that systemic CNS changes occurred in patients from the clean-up worker groups, especially in those with psycho-organic syndrome.

The question of the genesis of mental disturbances in workers involved in the clean-up at the Chernobyl atomic energy station accident has recently received increasing attention in the scientific literature. Complex studies of patients have led investigators to the conclusion that the conditions are organic (or somatogenic-organic), with the probable involvement of a progressive vascular process in the pathogenesis [5]. EEG studies of these patients have shown characteristic disturbances in brain electrical activity [8-10], at levels which correlate with the radiation dose [10]. Inhomogeneous EEG patterns were obtained, with two changes which are opposite in nature: increases in the synchronization of the $\alpha$-rhythm and weakening of the $\alpha$-rhythm [2]. However, virtually no attempt has been made to correlate the severity of mental disturbance in patients among the Chernobyl clean-up workers with features of the EEG changes. The aim of the present work was to carry out electrophysiological evaluations of the functional state of the brain and its reactivity, using electroencephalography and skin-galvanic responses in patients involved in the Chernobyl clean-up, and to compare the results with the level of mental disturbance.

Studies were carried out on 150 right-handed male clean-up workers aged 30-58 years. All showed signs of mental disturbance of different severity, several years after the accident. These were predominantly asthenic and neurosis-like states, as well as intellectual and memory disturbances. Disturbances were generally combined with autonomic-vascular disturbances. The clinical psychopathological and syndromological structure of these disturbances has previously been described by V. N. Krasnov et al. [5].

EEG traces were taken from all patients before treatment, in the restful waking state with the eyes closed, using 16-channel EEG recorders (Medicor and Nippon Coden). Electrodes were used according to the international 10-20 system in the occipital (O1, O2), (P3, P4), central (C3, C4), frontal (F3, F4), and temporal (F7, F8, T3, T4) regions. The reference
TABLE 1. Distribution of Patients by EEG Type Against Clinical Syndrome

<table>
<thead>
<tr>
<th>EEG Type</th>
<th>Simple asthenic</th>
<th>Autonomic-dystonic</th>
<th>Neurosis-like</th>
<th>Depressive</th>
<th>Psycho-organic</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type A</td>
<td>1</td>
<td>3</td>
<td>11</td>
<td>0</td>
<td>25</td>
<td>40</td>
</tr>
<tr>
<td>Type B</td>
<td>2</td>
<td>5</td>
<td>9</td>
<td>4</td>
<td>38</td>
<td>58</td>
</tr>
<tr>
<td>Type P</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>Type M</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>3 (2.7%)</td>
<td>8 (7.2%)</td>
<td>22 (19.8%)</td>
<td>4 (3.6%)</td>
<td>74 (66.7%)</td>
<td>111 (100%)</td>
</tr>
</tbody>
</table>

Paroxysmal phenomena

- Discharges: 2, 3, 8, 2, 18
- Paroxysms: 0, 0, 0, 0, 3

Data were analyzed visually and by computer. Visual analysis consisted of evaluating the dominant activity, the extent and spatial distribution of the basic rhythms, and their amplitude-frequency characteristics, with subsequent classification into EEG types. Visual evaluation was used to assess reactivity.

Computer EEG analysis included computation and plotting of power spectra for the main EEG rhythms for each lead, which was performed by Fourier analysis for ten four-second EEG epochs for each subject; skull surface maps were then constructed showing the spatial distribution of rhythm density for the main ranges.

For comparison of clinical data and EEG results from two groups of patients — those with neurosis-like states and those with psycho-organic syndromes (13 and 30 patients respectively) — maps were averaged and compared statistically using Student’s t test, using the "Topographic Cartotech" program. Controls for this analysis consisted of data obtained in the same way from 17 healthy subjects (13 male, 4 female, aged 19-45 years).

Paroxysmal activity found on the EEG traces of some of the patients was analyzed as described by V. V. Gnezditskii et al. [1], using the "Brainloc" program.

VISUAL EEG ANALYSIS

EEG patterns from the patients showed variation. Visual analysis yielded the following most frequent EEG variants: type A — dominated by regular α-rhythms with normal zonal distribution or with smoothing of zonal differences, and a tendency to hypersynchronization (Fig. 1, a). This type of EEG was seen in 36% of patients; type B — with strengthening of β-activity at 13-20 Hz, diffuse, or more pronounced in the frontal-central and parietal zones. This type of EEG was found most often, in 52% of the patients. Strengthening of β-activity was usually seen as part of polyrhythm (in 40%) (Fig. 1, b) and more rarely on a background of a dominant α-rhythm (12%); type P consisted of so-called flat EEG traces with reduced levels of electrical activity (amplitude no greater than 30 μV), without an α-rhythm or with a low α-index (Fig. 1, p). This type of EEG trace was found in 9% of patients; type M, with a notable strengthening or dominance of θ- and Δ-activity, was found rarely, in less than 3% of patients.

In 33% of patients, EEG traces showed paroxysmal types of activity — mostly bilateral bursts of sharpened α-, β-, and θ-waves, and, rarely (in 3 patients), slow-wave paroxysms. Paroxysmal signs were present in all types of EEG pattern apart from the flat type.

Analysis of the frequencies of each type of EEG and of paroxysmal phenomena in different clinical groups of patients was carried out in 111 cases. The results are shown in Table 1. The data show that in our set of patients, most had